

The opinion in support of the decision being entered today was not written for publication and is not binding precedent of the Board.

Paper No. 16

UNITED STATES PATENT AND TRADEMARK OFFICE

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BEFORE THE BOARD OF PATENT APPEALS  
AND INTERFERENCES

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Ex parte GUY F. HUDSON  
and RICHARD C. ELLIOTT

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Appeal No. 2001-2203  
Application No. 09/007,949

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ON BRIEF

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Before BARRETT, RUGGIERO, and TIMM, Administrative Patent Judges.  
RUGGIERO, Administrative Patent Judge.

DECISION ON APPEAL

This is a decision on the appeal from the final rejection of claims 1-26. Claims 27-40 have been withdrawn from consideration as being directed to a non-elected species.

The claimed invention relates to a method for forming a contact electrically connected to a metallization line in which a heat treatment is applied to two interfacing metal layers of a plug and metallization line. The heat treatment causes a selected alloying element from one of the metal layers to diffuse into the other of the metal layers resulting in a substantially continuous

concentration gradient of the selected alloying element at the interface of the two metal layers.

Claim 1 is illustrative of the invention and reads as follows:

1. A method for forming a contact electrically connected to a metal line, the method comprising the steps of:

forming an insulation layer situated on a semiconductor substrate;

forming a contact hole in the insulation layer to expose a contact surface on said semiconductor substrate;

forming a first metal layer over the insulation layer, said first metal layer substantially filling the contact hole;

forming a second metal layer having a substantially planar top surface upon a top planar surface of said insulation layer and upon a top surface of said first metal layer, said second metal layer being in electrical contact with said contact surface on said semiconductor substrate;

heating said semiconductor substrate sufficiently to cause a selected alloying element from one of said first and second metal layers to diffuse into the other of said first and second metal layers, whereby there is a substantially continuous concentration diffusion gradient of said selected alloying element between said first metal layer and said second metal layer.

The Examiner relies on the following prior art:

Yu et al. (Yu)	5,244,534	Sep. 14, 1993
Lee et al. (Lee)	5,355,020	Oct. 11, 1994
Mathews et al. (Mathews)	5,580,821	Dec. 03, 1996
Wilson et al. (Wilson)	GB 2 169 446 A	Jul. 09, 1986

Claims 1-26, all of the appealed claims, stand finally rejected under 35 U.S.C. § 103(a). As evidence of obviousness, the

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Examiner offers Lee in view of Wilson with respect to claims 1-9 and 14-18, and adds Yu or Mathews, in the alternative, to the combination of Lee and Wilson with respect to claims 10-13 and 19-26.

Rather than reiterate the arguments of Appellants and the Examiner, reference is made to the Brief (Paper No. 14) and Answer (Paper No. 15) for the respective details.

#### OPINION

We have carefully considered the subject matter on appeal, the rejection advanced by the Examiner and the evidence of obviousness relied upon by the Examiner as support for the rejection. We have, likewise, reviewed and taken into consideration, in reaching our decision, Appellants' arguments set forth in the Brief along with the Examiner's rationale in support of the rejection and arguments in rebuttal set forth in the Examiner's Answer.

It is our view, after consideration of the record before us, that the evidence relied upon and the level of skill in the particular art would not have suggested to one of ordinary skill in the art the obviousness of the invention as set forth in appealed claims 1-26. Accordingly, we reverse.

In rejecting claims under 35 U.S.C. § 103, it is incumbent upon the Examiner to establish a factual basis to

support the legal conclusion of obviousness. See In re Fine, 837 F.2d 1071, 1073, 5 USPQ2d 1596, 1598 (Fed. Cir. 1988). In so doing, the Examiner is expected to make the factual determinations set forth in Graham v. John Deere Co., 383 U.S. 1, 17, 148 USPQ 459, 467 (1966), and to provide a reason why one having ordinary skill in the pertinent art would have been led to modify the prior art or to combine prior art references to arrive at the claimed invention. Such reason must stem from some teaching, suggestion or implication in the prior art as a whole or knowledge generally available to one having ordinary skill in the art. Uniroyal Inc. v. Rudkin-Wiley Corp., 837 F.2d 1044, 1051, 5 USPQ2d 1434, 1438 (Fed. Cir.), cert. denied, 488 U.S. 825 (1988); Ashland Oil, Inc. v. Delta Resins & Refractories, Inc., 776 F.2d 281, 293, 227 USPQ 657, 664 (Fed. Cir. 1985), cert. denied, 475 U.S. 1017 (1986); ACS Hosp. Sys., Inc. v. Montefiore Hosp., 732 F.2d 1572, 1577, 221 USPQ 929, 933 (Fed. Cir. 1984). These showings by the Examiner are an essential part of complying with the burden of presenting a prima facie case of obviousness. Note In re Oetiker, 977 F.2d 1443, 1445, 24 USPQ2d 1443, 1444 (Fed. Cir. 1992).

With respect to the Examiner's 35 U.S.C. § 103(a) rejection of independent claim 1, based on the combination of Lee and Wilson,

Appellants assert that the Examiner has failed to establish a prima facie case of obviousness since all of the claimed limitations are not taught or suggested by the applied prior art references. In particular, Appellants contend (Brief, pages 3-6), that neither Lee nor Wilson has any teaching or suggestion of the diffusion of a selected alloying element from a first metal into the other of the first and second metal layers resulting in a ". . . substantially continuous concentration diffusion gradient of said selected alloying element between said first metal layer and said second metal layer" as claimed.

After careful review of the Lee and Wilson references, in light of the arguments of record, we are in general agreement with Appellants' position as stated in the Brief. In particular, we find no disclosure in Lee, relied on by the Examiner as teaching the claimed diffusion gradient, of the diffusion between first and second metal layers as claimed that would satisfy the requirements of appealed claim 1. We note that, while the Examiner has cited (Answer, pages 4 and 5) several portions of the disclosure of Lee in support of the stated rejection, each of the cited portions are directed to different embodiments of the semiconductor device of Lee. For example, the disclosure at column 17, lines 30-66 in Lee is directed to the Figure 20 embodiment in which heat treatment

results in Si atoms being diffused into a metal layer 56. This diffusion, however, in contrast to the language of appealed claim 1, is from a silicon layer 55 to the metal layer 56, not from a first metal layer to a second metal layer as claimed. Similarly, the disclosure at column 19, lines 1-45 in Lee describes an embodiment in which diffusion of Si atoms is from a refractory metal silicide layer 95 into metal layer 97, not from a first metal layer into a second metal layer as claimed.

In our view, the most relevant passage in Lee cited by the Examiner is column 15, lines 43-60 which describes the embodiment illustrated in Lee's Figure 13. A first conductive layer is formed by depositing a first metal layer 35 with a Si component followed by a second metal layer 36 with no Si component. During heat treatment, Si atoms from layer 35 are diffused into layer 36 and the resultant heat treatment formed layer 37 fills contact hole opening 33 as illustrated in Figure 13. It is apparent to us, however, that to whatever extent Lee's disclosed diffusion could be considered as forming a "substantially continuous concentration diffusion gradient" between layers 35 and 36, the layer 36 does not correspond to Appellants' second metal layer as claimed. As set forth in appealed claim 1, the second metal layer requires a planarized surface over the top surface of an insulating layer and

upon a top surface of the first metal layer, characteristics which are not present in layer 36 in Lee. While the description of this embodiment in Lee proceeds with the deposition of a second conductive layer 38 formed of metal which is planarized during a subsequent heat treatment, this metal layer is not involved in the earlier described silicon atom diffusion process.

We have also reviewed the Wilson reference and find no disclosure which cures the deficiencies of Lee in disclosing the required continuous concentration gradient diffusion between first and second metal layers as particularly set forth in appealed claim 1. We agree with Appellants (Brief, page 6) that, while Wilson describes the use of two metallization layers with different compositions, there is no disclosure of any heat treatment at all, let alone a heat treatment that would produce the continuous concentration diffusion gradient as claimed.

In view of the above discussion, since the Examiner has not established a prima facie case of obviousness, the 35 U.S.C. § 103(a) rejection of independent claim 1, as well as claims 2-9 and 14-18 dependent thereon, based on the combination of Lee and Wilson, is not sustained.

We also do not sustain the Examiner's obviousness rejection of claims 10-13 and 19-26 in which the Yu and Mathews references are

added, in the alternative, to the combination of Lee and Wilson. Claims 10-13 and 19-26 include details of a planarization procedure in which the first deposited metal layer and the insulation layer are planarized to the same plane followed by deposition of a second metal layer. To address the recognized deficiencies of the proposed combination of Lee and Wilson in disclosing the claimed planarization features, the Examiner turns to Yu and Mathews. Our review of Yu and Mathews, however, reveals that, at best, they disclose the beneficial aspects of providing planarized plugs that have improved surface contact areas. Given this limited teaching value of Yu and Mathews, we fail to see why the skilled would have been motivated to modify the Examiner's proposed combination of Lee and Wilson with Yu or Mathews since Lee, in each of the disclosed embodiments, already provides a planarized metal layer. For example, in Lee's Figure 13 embodiment, a deposited metal layer 38 is heat treated to form a planarized layer 39 as illustrated in Figure 15. Similar heat treatment to form planarization layers 59, 79, 99, and 119 in other embodiments in Lee are also described.



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In conclusion, we have not sustained the Examiner's 35 U.S.C.  
§ 103(a) rejection of any the claims on appeal. Accordingly, the  
decision of the Examiner rejecting claims 1-26 is reversed.

REVERSED

LEE E. BARRETT	)	
Administrative Patent Judge	)	
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	)	
	)	BOARD OF PATENT
JOSEPH F. RUGGIERO	)	APPEALS
Administrative Patent Judge	)	AND
	)	INTERFERENCES
	)	
	)	
	)	
CATHERINE TIMM	)	
Administrative Patent Judge	)	

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